



# SEMIANNUAL REPORT

Aggregated Data from the National Nosocomial Infections Surveillance (NNIS) System

December 2000

## CONTENTS

NNIS Personnel .....	Back of front cover
Introduction .....	1

### Intensive Care Unit Surveillance Component

Table 1. Pooled means and percentiles of the distribution of device-associated infection rates, by type of ICU, January 1995-November 2000 .....	4
Table 2. Pooled means and percentiles of the distribution of device utilization ratios, by type of ICU, January 1995-November 2000 .....	6
Figure 1. Selected antimicrobial resistant pathogens associated with nosocomial infections in ICU patients, comparison of resistance rates from January-December 1999 with 1994-1998* .....	8

### High Risk Nursery Surveillance Component

Table 3. Pooled means and percentiles of the distribution of device-associated infection rates, by birthweight category, January 1995-November 2000 .....	9
Table 4. Pooled means and percentiles of the distribution of device utilization ratios, by birthweight category, January 1995-November 2000 .....	10

### Surgical Patient Surveillance Component\*

Table 5. Surgical site infection rates, by operative procedure and risk index category, January 1992-April 2000 .	11
Table 6. Percentiles of the distribution of surgical site infection rates, by operative procedure and risk index category, January 1992-April 2000 .....	13
Table 7. Surgical site infection rates, by selected operative procedure and modified risk index category incorporating laparoscope use, January 1992-April 2000 .....	16
Table 8. Surgical site infection rates following coronary artery bypass graft (CBGB) operation, by risk index category and specific site, January 1992-April 2000 .....	17

### Intensive Care Antimicrobial Resistance Epidemiology (ICARE Project)

Table 9. Pooled means and percentiles of the distribution of antimicrobial usage rates, by non-ICU inpatient areas and various types of ICU, January 1996-November 2000 .....	18
Table 10. Pooled means and percentiles of the distribution of antimicrobial resistance rates by all ICUs combined, by non-ICU inpatient units and by outpatients, January 1996-November 2000 .....	27

### How To Analyze Your Data Using IDEAS

Appendix A. Defined Daily Dose (DDD) of antimicrobial agents, by class and group .....	30
Appendix B. How to calculate device-associated infection rates and device utilization ratios using ICU and HRN surveillance component data .....	32
Appendix C. How to interpret percentiles of infection rates or device utilization ratios .....	34
Appendix D. How to use IDEAS to calculate SSI rates from the surgical patient surveillance component .....	35

\*Data unchanged from June 2000 NNIS SAR

NNIS SAR  
December 2000



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
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## INTRODUCTION

The data in the SEMIANNUAL REPORT (SAR) are collected by hospitals that voluntarily participate in the National Nosocomial Infections Surveillance (NNIS) system and routinely report their data to the Centers for Disease Control and Prevention. The hospitals use the NNIS surveillance components, which are protocols that target specific patient groups with similar infection risks, to collect the data.

In January of 1999, the Hospital-wide component was eliminated from the NNIS system. This was done for several reasons. The Hospital-wide component required considerable time and resources in most hospitals, particularly those that have a large and high-risk patient population, resulting in inaccurate and inadequate case-finding. More importantly, the Hospital-wide component did not yield rates that were meaningful for national comparison purposes since they were not risk-adjusted.

Tables 1 and 2 update the device-associated rates and device utilization ratios from the ICU component reported in the last SAR, issued in June 2000. In the December 1998 SAR we separated for the first time combined Medical-Surgical ICUs into two groups by type of hospital: Major Teaching and All Other. The combined Medical/Surgical ICUs from major teaching hospitals had significantly higher infection rates and device utilization ratios than combined medical/surgical ICUs from all of the other hospitals. Major Teaching status is defined as a hospital that is an important part of the teaching program of a medical school and a major unit in the clinical clerkship program. Teaching affiliation was not an important factor for any other type of ICU.

We require a minimum of 50 device-days in the denominator of an ICU to calculate a device-associated infection rate. Similarly, device utilization ratios are calculated for ICUs that reported at least 50 patient-days. The distribution of device utilization ratios can be useful as a guide for assessing the appropriateness of device use in your hospital's ICU. The percentile distributions that display the infection rates and device utilization ratios require data from at least 20 different units. The number of units reporting data from the burn and respiratory ICUs is still insufficient to provide percentile distributions for these types of ICUs.

Figure 1 summarizes the rates of antimicrobial resistance among pathogens identified from ICU patients with nosocomial infections. The figure summarizes several important points for the more common pathogens reported to NNIS. First, we provide the pooled mean rate of resistance for January-December 1999. Second, we graph this rate next to the average rate of resistance ( $\pm 1$  standard deviation) over the previous 5 years, for each pathogen. Finally, we calculate the percentage increase in the resistance rate in 1999 compared to the previous 5 years. These data display the concerning and continuing increase in antimicrobial resistance in U.S. hospitals. However the rate of increase has diminished for several pathogens, including VRE (reported as +55% in 1998 compared to +40% in 1999), *K. pneumoniae* not susceptible to cephalosporins (reported as +7% in 1998 compared to 0% in 1999). Although these data are limited to patients in ICUs, they are not risk-adjusted and comparisons of these rates between hospitals should be made with caution.

Tables 3 and 4 show updated data from the HRN component.

The data in Tables 5-8 are unchanged from the June 2000 SAR.

Table 5 displays SSI rates by operative procedure and NNIS risk index category. When the SSI rates for adjacent risk categories for a particular operation were not statistically different, we combined them into a single risk category. For example, because the SSI rates for cardiac surgery operations with 2 or 3 risk factors were similar, we collapsed the data for these two categories into one category designated as '2,3'. Thus, the number of risk index categories in the tables will differ depending upon the operation.

Table 6 contains the percentile distributions for each operative procedure and SSI risk index category. For a hospital to be represented in this distribution, it must have reported sufficient data, which means it reported at least 20 operations in a given SSI risk category. Note that percentile distributions are not available for every operative procedure-risk category since percentile distributions of the procedure-specific and risk-index specific rates required sufficient data from at least 20 hospitals.

Table 7 lists four operations in which the use of a laparoscope has been incorporated into the SSI risk index. Laparoscopes and endoscopes (SCOPE) are being used with increasing frequency to perform operations. For four operations, the SSI rate was significantly different when SCOPE was used. When other risk factors were controlled, Cholecystectomy, Colon Surgery, Gastric Surgery, and Appendectomy had lower SSI rates when a SCOPE was used. However, there were some differences among these operations. For Cholecystectomy and Colon Surgery, the influence of SCOPE was captured by subtracting one from the number of risk factors (ASA score of 3,4, or 5; duration of surgery >75<sup>th</sup> percentile; or contaminated or dirty wound class) whenever the procedure was done laparoscopically; M indicates minus 1 (-1) in the modified risk category where no risk factors were present and the procedure was performed with a laparoscope. For Appendectomy and Gastric Surgery, the use of a SCOPE was only important if the patient had no other risk factors. Therefore, we split the index value of zero risk factors into 0-No and 0-Yes. The percentile distributions of the four operative procedures with modified SSI risk index categories have not been developed at this time.

Table 8 displays SSI rates by specific site following Coronary Artery Bypass Graft (CBGB) operations where incisions are made at both the chest and the donor sites.

The data in Tables 9 and 10 are updated from those reported in the December 1999 SAR. The data are from Phases 2 and 3 (January 1996-November 2000) of the Intensive Care Antimicrobial Resistance Epidemiology, (ICARE) Project and update previously published reports. These tables are similar in structure to the device-associated nosocomial infection rates in the SAR. For the purpose of analysis, grams of antimicrobial agents were converted into number of defined daily doses (DDD) used each month in each hospital area. A DDD is the average daily dose in grams of a specific antimicrobial agent given to an average adult patient (Appendix A). Table 9 shows use of selected oral and parenteral antimicrobial agents in DDD. Antimicrobial use was stratified by route of administration and hospital area. Because outpatient antimicrobial use could not be estimated reliably from hospital pharmacy records, we did not collect data on outpatient antimicrobial use. Finally, antimicrobial agents with similar spectrum or clinical indications were grouped in Appendix A. Based on detailed analysis, antimicrobial use rates were found to vary by type of ICU, so use rates and percentiles are calculated for each type of ICU. The number of burn, respiratory, trauma, and neurosurgical ICUs reporting data is still insufficient to provide percentile distributions for these types of ICUs. Table 10 shows ICARE

resistance data for selected antimicrobial-resistant bacteria based on reported antimicrobial susceptibility test results on all nonduplicate clinical isolates processed by the laboratory during each study month. A duplicate isolate was defined as an isolate of the same species of bacteria with the same antimicrobial susceptibility pattern in the same patient in the same month, regardless of the site of isolation. All isolates, whether responsible for hospital-acquired or community-acquired infection or for colonization, were reported to ICARE by participating hospitals. Hospitals used National Committee for Clinical Laboratory Standards interpretive standards for minimum inhibitory concentration, or zone diameter testing standards to report numbers of susceptible, intermediate, or resistant organisms. We require a minimum of 10 isolates to be tested in a hospital area for resistance rates to be calculated for that area. We have combined resistance data among all ICU types because detailed analysis demonstrated that, in general, resistance rates (% prevalence) did not differ between ICU types. Also, these data show that for most antimicrobial resistant bacteria, resistance rates are highest in the ICU areas, followed by non-ICU inpatient areas, with lowest rates in the outpatient areas.

Appendix A shows the defined daily dose for antimicrobial agents that are shown in Table 9.

Appendix B and C provide instructions on how to calculate the rates and ratios found in the SAR and how to interpret the data. All individuals who analyze and use surveillance data must remember that a high rate or ratio (>90th percentile) does NOT define a problem, it only suggests an area for further investigation. Appendix D shows NNIS personnel how to use the NNIS surveillance software, IDEAS, to calculate SSI rates on data collected through the surgical patient surveillance component.

The mid-year issue of the NNIS Semiannual Report is published in the American Journal of Infection Control and is posted on the CDC web page. The address is [www.cdc.gov/ncidod/hip/surveill/nnis.htm](http://www.cdc.gov/ncidod/hip/surveill/nnis.htm).

**Table 1. Intensive care unit surveillance component. Pooled means and percentiles of the distribution of device-associated infection rates, by type of ICU, NNIS system, January 1995-November 2000**

<b>Urinary catheter-associated UTI rate*</b>				<b>Percentile</b>				
<b>Type of ICU</b>	<b>No. of Units</b>	<b>Urinary Catheter-Days</b>	<b>Pooled Mean</b>	<b>10%</b>	<b>25%</b>	<b>50% (median)</b>	<b>75%</b>	<b>90%</b>
Coronary	99	366,302	5.8	0.9	2.6	5.1	8.5	11.0
Cardiothoracic	62	420,226	3.1	0.4	1.2	2.3	3.7	4.8
Medical	130	876,207	6.7	2.5	4.2	6.0	7.8	10.3
Medical-Surgical								
Major teaching	113	757,985	6.0	1.4	3.2	5.3	7.2	10.3
All others	171	1,280,104	3.8	0.8	1.8	3.8	5.4	6.8
Neurosurgical	46	213,456	8.0	2.2	4.3	7.0	9.4	12.1
Pediatric	68	186,380	5.1	0.0	2.3	4.5	6.9	8.9
Surgical	146	1,060,309	5.2	1.4	2.9	4.4	7.0	9.0
Trauma	24	142,850	6.8	3.8	4.6	6.4	8.3	10.1
Burn	17	43,732	9.8	.	.	.	.	.
Respiratory	6	31,411	5.5	.	.	.	.	.

<b>Central line-associated BSI rate**</b>				<b>Percentile</b>				
<b>Type of ICU</b>	<b>No. of Units</b>	<b>Central Line-Days</b>	<b>Pooled Mean</b>	<b>10%</b>	<b>25%</b>	<b>50% (median)</b>	<b>75%</b>	<b>90%</b>
Coronary	100	229,805	4.4	0.0	1.8	4.0	5.6	7.8
Cardiothoracic	62	378,378	2.8	0.4	1.5	2.4	3.7	4.9
Medical	131	617,263	6.0	2.2	3.6	5.3	7.1	9.9
Medical-Surgical								
Major teaching	114	515,828	5.3	2.0	3.1	5.0	7.0	8.2
All others	173	787,222	3.9	0.0	1.9	3.4	5.2	6.9
Neurosurgical	46	113,996	4.7	0.0	2.6	4.4	5.8	8.2
Pediatric	70	261,166	7.7	0.0	4.0	6.5	8.9	12.0
Surgical	145	830,145	5.3	1.3	2.6	4.9	7.1	9.2
Trauma	24	102,121	8.0	1.8	5.8	7.8	9.6	10.9
Burn	17	37,272	10.0	.	.	.	.	.
Respiratory	6	20,081	3.5	.	.	.	.	.

**Table 1 - continued**

<b>Ventilator-associated pneumonia rate***</b>				<b>Percentile</b>				
<b>Type of ICU</b>	<b>No. of Units</b>	<b>Ventilator-Days</b>	<b>Pooled Mean</b>	<b>10%</b>	<b>25%</b>	<b>50% (median)</b>	<b>75%</b>	<b>90%</b>
Coronary	98	157,389	8.6	0.3	4.3	6.9	10.9	16.9
Cardiothoracic	62	226,731	10.7	3.1	5.4	9.3	14.1	18.0
Medical	130	588,012	7.4	2.1	3.9	6.5	9.1	13.6
Medical-Surgical								
Major teaching	113	441,387	10.8	2.8	6.1	9.4	13.2	17.4
All others	172	616,223	8.9	1.3	5.0	7.8	10.6	13.5
Neurosurgical	45	99,980	15.0	3.9	8.3	11.6	17.4	22.5
Pediatric	72	259,669	5.0	0.0	1.4	3.7	7.4	10.5
Surgical	146	589,142	13.4	5.7	7.9	12.1	14.9	23.3
Trauma	24	93,775	16.3	8.7	11.2	15.2	22.8	28.4
Burn	17	25,747	15.5	.	.	.	.	.
Respiratory	6	22,944	4.2	.	.	.	.	.

\* Number of urinary catheter-associated UTIs x 1000  
Number of urinary catheter-days

\*\* Number of central line-associated BSIs x 1000  
Number of central line-days

\*\*\* Number of ventilator-associated pneumonias x 1000  
Number of ventilator-days

**Table 2. Intensive care unit surveillance component. Pooled means and percentiles of the distribution of device utilization ratios, by type of ICU, NNIS system, January 1995-November 2000**

<b>Urinary catheter utilization*</b>				<b>Percentile</b>				
<b>Type of ICU</b>	<b>No. of Units</b>	<b>Patient-Days</b>	<b>Pooled Mean</b>	<b>10%</b>	<b>25%</b>	<b>50% (median)</b>	<b>75%</b>	<b>90%</b>
Coronary	99	741,451	0.49	0.24	0.37	0.49	0.62	0.72
Cardiothoracic	62	477,822	0.88	0.72	0.80	0.91	0.95	0.97
Medical	130	1,201,320	0.73	0.54	0.64	0.75	0.82	0.87
Medical-Surgical								
Major teaching	114	942,669	0.80	0.56	0.72	0.80	0.87	0.91
All others	171	1,709,136	0.75	0.58	0.67	0.75	0.82	0.88
Neurosurgical	46	262,741	0.81	0.52	0.76	0.84	0.92	0.94
Pediatric	76	572,820	0.33	0.13	0.18	0.28	0.38	0.45
Surgical	146	1,254,077	0.85	0.70	0.78	0.85	0.92	0.96
Trauma	24	162,626	0.88	0.70	0.86	0.93	0.95	0.97
Burn	17	76,860	0.57	.	.	.	.	.
Respiratory	6	44,990	0.70	.	.	.	.	.

<b>Central line utilization**</b>				<b>Percentile</b>				
<b>Type of ICU</b>	<b>No. of Units</b>	<b>Patient-Days</b>	<b>Pooled Mean</b>	<b>10%</b>	<b>25%</b>	<b>50% (median)</b>	<b>75%</b>	<b>90%</b>
Coronary	100	741,451	0.31	0.13	0.21	0.27	0.40	0.54
Cardiothoracic	62	477,822	0.79	0.56	0.71	0.82	0.91	0.95
Medical	131	1,201,320	0.51	0.30	0.36	0.51	0.64	0.74
Medical-Surgical								
Major teaching	114	942,669	0.55	0.34	0.45	0.56	0.64	0.73
All others	173	1,709,136	0.46	0.26	0.33	0.46	0.56	0.63
Neurosurgical	46	262,741	0.43	0.26	0.36	0.47	0.54	0.63
Pediatric	76	572,820	0.46	0.19	0.30	0.40	0.54	0.60
Surgical	146	1,254,077	0.66	0.46	0.55	0.68	0.76	0.87
Trauma	24	162,626	0.63	0.47	0.55	0.63	0.79	0.85
Burn	17	76,860	0.48	.	.	.	.	.
Respiratory	6	44,990	0.45	.	.	.	.	.



**Table 2 - continued**

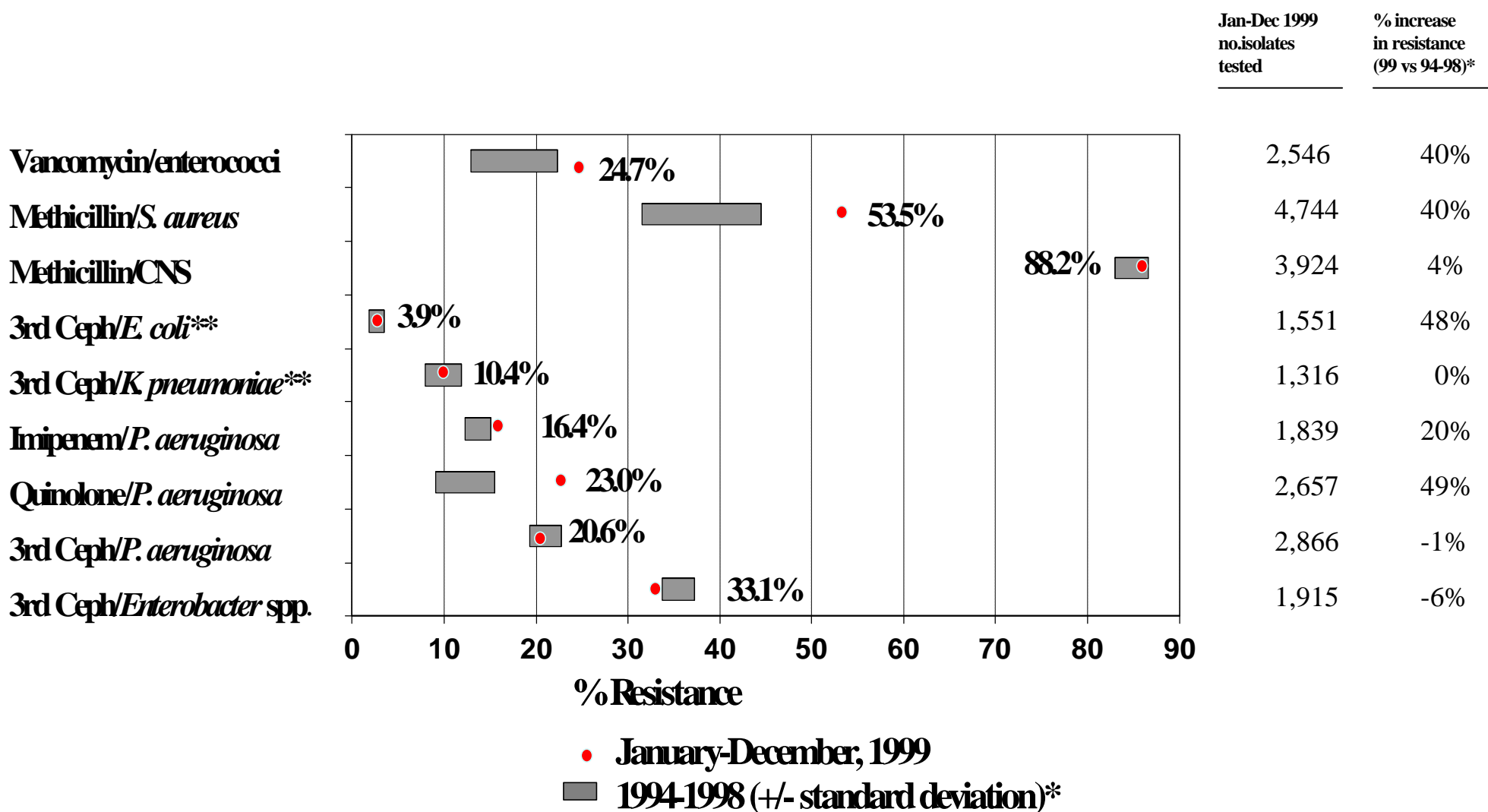
<b>Ventilator utilization***</b>				<b>Percentile</b>				
<b>Type of ICU</b>	<b>No. of Units</b>	<b>Patient-Days</b>	<b>Pooled Mean</b>	<b>10%</b>	<b>25%</b>	<b>50% (median)</b>	<b>75%</b>	<b>90%</b>
Coronary	99	741,451	0.21	0.08	0.12	0.20	0.27	0.36
Cardiothoracic	62	477,822	0.47	0.32	0.39	0.47	0.55	0.65
Medical	132	1,201,320	0.49	0.24	0.37	0.47	0.59	0.67
Medical-Surgical								
Major teaching	114	942,669	0.47	0.27	0.36	0.43	0.54	0.63
All others	173	1,709,136	0.36	0.21	0.27	0.36	0.43	0.49
Neurosurgical	46	262,741	0.38	0.19	0.26	0.38	0.46	0.54
Pediatric	77	572,820	0.45	0.17	0.29	0.41	0.49	0.59
Surgical	146	1,254,077	0.47	0.26	0.35	0.46	0.56	0.65
Trauma	24	162,626	0.58	0.45	0.56	0.62	0.71	0.75
Burn	17	76,860	0.33	.	.	.	.	.
Respiratory	6	44,990	0.51	.	.	.	.	.

\* Number of urinary catheter-days  
Number of patient-days

\*\* Number of central line-days  
Number of patient-days

\*\*\* Number of ventilator-days  
Number of patient-days

**Figure 1. Selected antimicrobial resistant pathogens associated with nosocomial infections in ICU patients, comparison of resistance rates from January-December 1999 with 1994-1998, NNIS System**



Note: CNS=coagulase-negative staphylococci, 3rd Ceph = resistance to 3rd generation cephalosporins (either ceftriaxone, cefotaxime, or ceftazidime), Quinolone=resistance to either ciprofloxacin or ofloxacin.

\* Percentage (%) increase in resistance rate of current period (January-December 1999) compared to mean rate of resistance over previous 5 years (1994 through 1998):  $[(1999 \text{ rate} - \text{previous 5 year mean rate}) / \text{previous 5 year mean rate}] * 100$ .

\*\* "Resistance" for *E. coli* or *K. pneumoniae* is the rate of non-susceptibility of these organisms to either 3rd Ceph group or aztreonam.

**Table 3. High risk nursery surveillance component. Pooled means and percentiles of the distribution of device-associated infection rates, by birthweight category, NNIS system, January 1995-November 2000**

Umbilical and central line-associated BSI rate*				Percentile				
Birthweight Category	No. of HRNs	Central-Line Days	Pooled Mean	10%	25%	50% (median)	75%	90%
≤ 1000 grams	133	400,001	11.4	4.1	7.4	11.3	15.2	18.2
1001-1500 grams	128	193,236	6.9	1.3	4.3	6.7	10.5	13.7
1501-2500 grams	127	146,443	4.0	0.0	1.2	3.9	6.3	9.0
> 2500 grams	130	208,591	3.8	0.0	0.0	2.7	5.3	7.7

Ventilator-associated pneumonia rate**				Percentile				
Birthweight Category	No. of HRNs	Ventilator-Days	Pooled Mean	10%	25%	50% (median)	75%	90%
≤ 1000 grams	133	397,891	4.8	0.0	1.3	4.1	7.4	11.0
1001-1500 grams	127	118,803	3.6	0.0	0.0	2.6	6.2	9.5
1501-2500 grams	122	87,718	2.9	0.0	0.0	1.1	3.6	5.9
> 2500 grams	123	132,979	2.6	0.0	0.0	1.0	3.2	6.8

\* Number of umbilical and central line-associated BSIs x 1000  
Number of umbilical and central line-days

\*\* Number of ventilator-associated pneumonias x 1000  
Number of ventilator-days

**Table 4. High risk nursery surveillance component. Pooled means and percentiles of the distribution of device utilization ratios, by birthweight category, NNIS system, January 1995-November 2000**

<b>Umbilical and central line utilization ratio*</b>				<b>Percentile</b>				
<b>Birthweight Category</b>	<b>No. of HRNs</b>	<b>Patient-Days</b>	<b>Pooled Mean</b>	10%	25%	50% (median)	75%	90%
≤ 1000 grams	138	963,682	0.42	0.19	0.27	0.40	0.54	0.64
1001-1500 grams	137	672,573	0.29	0.09	0.15	0.25	0.40	0.56
1501-2500 grams	138	725,000	0.20	0.05	0.09	0.14	0.31	0.45
> 2500 grams	138	676,187	0.31	0.08	0.14	0.22	0.40	0.54

<b>Ventilator utilization ratio**</b>				<b>Percentile</b>				
<b>Birthweight Category</b>	<b>No. of HRNs</b>	<b>Patient-Days</b>	<b>Pooled Mean</b>	<b>10%</b>	<b>25%</b>	<b>50% (median)</b>	<b>75%</b>	<b>90%</b>
≤ 1000 grams	138	963,682	0.41	0.25	0.30	0.39	0.49	0.63
1001-1500 grams	137	672,573	0.18	0.07	0.11	0.15	0.24	0.37
1501-2500 grams	138	725,000	0.12	0.03	0.05	0.09	0.17	0.32
> 2500 grams	138	676,187	0.20	0.05	0.07	0.13	0.23	0.34

\*Number of umbilical and central line-days  
Number of patient-days

\*\*Number of ventilator-days  
Number of patient-days

**Table 5. Surgical patient surveillance component. Surgical site infection rates‡, by operative procedure and risk index category, NNIS system, January 1992-April 2000**

Operative Procedure Category		Duration Cutpoint (hrs)	Risk Index Category	N	Rate	Risk Index Category	N	Rate	Risk Index Category	N	Rate	Risk Index Category	N	Rate
CARD	Cardiac Surgery	5	0	1393	0.65	1	23731	1.62	2,3	7243	2.53		.	.
CBGB*	CABG-Chest & Leg	5	0	1573	1.14	1	199807	3.56	2	39302	5.65	3	108	10.19
CBGC**	CABG-Chest Only	4	0,1	9756	2.18	2,3	3947	3.72		.	.		.	.
OCVS	Other Cardiovascular Surgery	2	0,1	7360	0.65	2	2566	1.48	3	112	4.46		.	.
ORES	Other Respiratory System	2	0,1,2,3	1502	2.73		.	.		.	.		.	.
THOR	Thoracic Surgery	3	0	1120	0.36	1	3700	1.22	2,3	1264	3.16		.	.
BILI	Liver/Pancreas	4	0	360	3.06	1,2,3	1304	7.36		.	.		.	.
OGIT	Other Digestive Surgery	3	0,1	2834	3.00	2,3	518	7.14		.	.		.	.
SB	Small Bowel Surgery	3	0	1210	5.04	1	2722	7.09	2,3	1670	9.58		.	.
XLAP	Laparotomy	2	0	4884	1.72	1	5678	3.15	2	2999	5.24	3	501	8.78
NEPH	Nephrectomy	4	0,1,2,3	2563	1.17		.	.		.	.		.	.
OGU	Other Genitourinary Surgery	2	0	10718	0.37	1	5360	1.06	2,3	1295	3.09		.	.
PRST	Prostatectomy	4	0	2109	0.90	1	1461	2.12	2,3	250	4.80		.	.
HN	Head and Neck	7	0	512	2.54	1	717	5.16	2,3	335	14.03		.	.
OENT	Other ENT	2	0,1	3086	0.23	2,3	325	2.77		.	.		.	.
HER	Herniorrhaphy	2	0	8806	0.73	1	5120	1.87	2	1141	3.68	3	36	11.11
MAST	Mastectomy	3	0	10512	1.89	1	6527	2.50	2,3	630	3.97		.	.
CRAN	Craniotomy	4	0	3065	0.82	1,2,3	11665	1.66		.	.		.	.
ONS	Other Nervous System	4	0,1,2,3	1953	1.59		.	.		.	.		.	.
VSHN	Ventricular Shunt	2	0	2346	3.92	1,2,3	5562	5.16		.	.		.	.

Table 5 - continued

Operative Procedure Category		Duration Cutpoint (hrs)	Risk Index Category	N	Rate	Risk Index Category	N	Rate	Risk Index Category	N	Rate	Risk Index Category	N	Rate
CSEC	Cesarean Section	1	0	96139	3.35	1	29897	5.06	2,3	2996	8.11		.	.
HYST	Abdominal Hysterectomy	2	0	27763	1.46	1	14267	2.36	2,3	3040	5.69		.	.
OOB	Other Obstetrical Procedures	1	0,1,2,3	974	0.41		.	.		.	.		.	.
VHYS	Vaginal Hysterectomy	2	0,1,2,3	17844	1.27		.	.		.	.		.	.
AMP	Limb Amputation	1	0,1,2,3	7814	3.80		.	.		.	.		.	.
FUSN	Spinal Fusion	4	0	22437	1.23	1	12112	2.86	2,3	3134	6.64		.	.
FX	Open Reduction Fracture	2	0	11045	0.68	1	17525	1.34	2	3476	2.30	3	394	4.82
HPRO	Hip Prosthesis	2	0	18660	0.86	1	31844	1.48	2,3	9033	2.20		.	.
KPRO	Knee Prosthesis	2	0	26852	0.80	1	31308	1.17	2,3	8252	2.16		.	.
LAM	Laminectomy	2	0	37578	0.90	1	26343	1.39	2,3	7911	2.53		.	.
OMS	Other Musculoskeletal	3	0	12991	0.63	1	8936	0.87	2,3	2517	1.71		.	.
OPRO	Other Prosthesis	3	0,1,2,3	2010	0.70		.	.		.	.		.	.
OBL	Other Hem/Lymph System	3	0,1,2,3	921	1.95		.	.		.	.		.	.
OES	Other Endocrine System	3	0	1755	0.11	1,2,3	1313	0.99		.	.		.	.
OEYE	Other Eye	2	0,1,2,3	493	0.81		.	.		.	.		.	.
OSKN	Other Integumentary System	2	0,1,2,3	6665	1.28		.	.		.	.		.	.
SKGR	Skin Graft	3	0	881	0.91	1	1542	2.08	2,3	1110	5.14		.	.
SPLE	Splenectomy	2	0	312	0.96	1,2,3	951	3.36		.	.		.	.
TP	Organ Transplant	6	0,1	2645	4.65	2	1065	15.12	3	32	28.13		.	.
VS	Vascular Surgery	3	0	5392	0.82	1	44398	1.76	2,3	18172	4.60		.	.

‡ per 100 operations

\*CABG-Chest and Leg = coronary artery bypass graft, chest and leg (donor) incisions

\*\*CABG-Chest Only = coronary artery bypass graft, chest incision only (example: internal mammary artery)

**Table 6. Surgical patient surveillance component. Percentiles of the distribution of surgical site infection rates<sup>†</sup>, by operative procedure and risk index category<sup>§</sup>, NNIS system, January 1992 - April 2000**

Operative Procedure Category	Risk Index Category	No. Hospitals	Pooled Mean Rate	Percentile				
				10%	25%	50% (median)	75%	90%
CARD Cardiac Surgery	1	90	1.62	0.00	0.20	1.25	1.93	2.78
CARD Cardiac Surgery	2,3	64	2.53	0.00	0.00	1.75	3.45	5.54
CBGB* CABG-Chest & Leg	1	157	3.56	1.32	2.14	3.18	4.51	6.50
CBGB* CABG-Chest & Leg	2	142	5.65	2.00	3.41	5.45	7.57	9.63
CBGC** CABG-Chest Only	0,1	81	2.18	0.00	0.00	1.39	3.29	4.98
CBGC** CABG-Chest Only	2,3	45	3.72	0.00	0.00	2.80	4.35	7.32
OCVS Oth Cardiovascular Surg.	0,1	29	0.65	0.00	0.00	0.00	0.89	2.29
THOR Thoracic Surgery	1	32	1.22	0.00	0.00	0.54	1.99	3.06
THOR Thoracic Surgery	2,3	20	3.16	0.00	0.00	1.67	3.77	6.12
APPY Appendectomy	0-No	41	1.40	0.00	0.00	0.96	2.35	3.03
APPY Appendectomy	1	48	2.95	0.00	1.32	2.56	3.96	5.62
APPY Appendectomy	2	29	4.94	0.00	0.30	3.00	6.48	7.99
CHOL Cholecystectomy	M	80	0.46	0.00	0.00	0.00	0.56	1.16
CHOL Cholecystectomy	0	84	0.68	0.00	0.00	0.32	1.11	1.96
CHOL Cholecystectomy	1	70	1.81	0.00	0.00	1.39	3.64	5.00
CHOL Cholecystectomy	2	45	3.17	0.00	0.83	2.89	4.55	8.58
COLO Colon Surgery	0	78	4.13	0.00	2.17	3.85	5.47	7.72
COLO Colon Surgery	1	89	5.83	1.13	3.28	5.35	7.14	8.79
COLO Colon Surgery	2	68	9.08	3.84	5.32	8.71	13.43	18.72
GAST Gastric Surgery	0-No	21	2.66	0.00	0.00	2.03	4.20	6.59
GAST Gastric Surgery	1	31	4.98	1.45	2.21	4.08	6.47	9.00
OGIT Other Digestive Surgery	0,1	21	3.00	0.00	1.50	2.63	4.19	7.36

Table 6 - continued

Operative Procedure Category	Risk Index Category	No. Hospitals	Pooled Mean Rate	Percentile				
				10%	25%	50% (median)	75%	90%
SB Small Bowel Surgery	0	21	5.04	0.00	1.69	4.50	6.14	11.66
SB Small Bowel Surgery	1	31	7.09	0.00	3.85	5.53	10.10	14.03
SB Small Bowel Surgery	2,3	23	9.58	5.21	6.44	8.11	13.23	15.50
XLAP Laparotomy	0	33	1.72	0.00	0.00	1.53	2.65	3.45
XLAP Laparotomy	1	40	3.15	0.00	1.10	2.36	4.27	7.03
XLAP Laparotomy	2	31	5.24	0.00	1.06	3.52	7.06	10.41
NEPH Nephrectomy	0,1,2,3	26	1.17	0.00	0.00	0.85	2.25	5.13
OGU Other Genitourinary Surgery	0	29	0.37	0.00	0.00	0.16	0.68	1.38
OGU Other Genitourinary Surgery	1	26	1.06	0.00	0.21	0.81	1.94	3.11
PRST Prostatectomy	0	25	0.90	0.00	0.00	0.00	1.05	2.47
HER Herniorrhaphy	0	43	0.73	0.00	0.00	0.29	1.48	2.31
HER Herniorrhaphy	1	44	1.87	0.00	0.00	1.42	3.08	4.57
MAST Mastectomy	0	47	1.89	0.00	0.00	0.75	1.73	3.20
MAST Mastectomy	1	43	2.50	0.00	0.42	1.89	4.09	6.39
CRAN Craniotomy	0	34	0.82	0.00	0.00	0.00	2.11	2.60
CRAN Craniotomy	1,2,3	58	1.66	0.00	0.00	1.38	2.25	3.60
VSHN Ventricular Shunt	0	23	3.92	0.00	0.00	3.15	4.93	6.71
VSHN Ventricular Shunt	1,2,3	37	5.16	0.00	0.22	3.59	6.05	9.05
CSEC Cesarean Section	0	116	3.35	0.28	1.18	2.30	4.94	8.53
CSEC Cesarean Section	1	107	5.06	0.00	1.36	3.35	6.26	9.04
CSEC Cesarean Section	2,3	36	8.11	0.00	4.46	7.32	11.11	13.95
HYST Abdominal Hysterectomy	0	81	1.46	0.00	0.44	1.18	2.58	4.11
HYST Abdominal Hysterectomy	1	78	2.36	0.00	0.00	1.64	2.70	5.32
HYST Abdominal Hysterectomy	2,3	42	5.69	0.00	2.60	4.76	9.15	12.00
VHYS Vaginal Hysterectomy	0,1,2,3	56	1.27	0.00	0.11	1.05	2.02	3.41
AMP Limb Amputation	0,1,2,3	36	3.80	0.00	1.50	3.01	5.30	7.40



Table 6 - continued

Operative Procedure Category	Risk Index Category	No. Hospitals	Pooled Mean Rate	Percentile				
				10%	25%	50% (median)	75%	90%
FUSN Spinal Fusion	0	74	1.23	0.00	0.00	0.71	1.53	2.49
FUSN Spinal Fusion	1	73	2.86	0.00	0.11	2.24	3.95	6.43
FUSN Spinal Fusion	2,3	39	6.64	0.00	2.93	5.38	7.32	10.84
FX Open Reduction Fracture	0	60	0.68	0.00	0.00	0.00	1.06	1.92
FX Open Reduction Fracture	1	67	1.34	0.00	0.00	0.98	1.67	2.08
FX Open Reduction Fracture	2	41	2.30	0.00	0.00	2.29	3.59	6.32
HPRO Hip Prosthesis	0	125	0.86	0.00	0.00	0.17	1.18	2.72
HPRO Hip Prosthesis	1	152	1.48	0.00	0.00	1.01	2.08	3.30
HPRO Hip Prosthesis	2,3	110	2.20	0.00	0.00	1.72	3.70	5.41
KPRO Knee Prosthesis	0	120	0.80	0.00	0.00	0.47	1.24	2.04
KPRO Knee Prosthesis	1	142	1.17	0.00	0.00	0.98	1.80	3.05
KPRO Knee Prosthesis	2,3	97	2.16	0.00	0.00	1.98	3.64	5.17
LAM Laminectomy	0	104	0.90	0.00	0.00	0.58	1.23	2.38
LAM Laminectomy	1	100	1.39	0.00	0.33	1.22	2.03	2.99
LAM Laminectomy	2,3	80	2.53	0.00	0.52	2.20	3.57	6.90
OMS Other Musculoskeletal	0	36	0.63	0.00	0.00	0.34	0.81	1.21
OMS Other Musculoskeletal	1	35	0.87	0.00	0.00	0.52	1.38	2.06
OPRO Other Prosthesis	0,1,2,3	26	0.70	0.00	0.00	0.00	1.05	1.89
OSKN Other Integumentary System	0,1,2,3	26	1.28	0.00	0.20	0.79	1.57	2.38
VS Vascular Surgery	0	58	0.82	0.00	0.00	0.00	1.37	2.69
VS Vascular Surgery	1	97	1.76	0.00	0.52	1.41	2.33	3.67
VS Vascular Surgery	2,3	89	4.60	0.00	2.62	4.56	6.65	9.14

‡ per 100 operations

§ Includes only those procedure-risk categories for which at least 20 hospitals have reported at least 20 operations

\*CABG-Chest and Leg = coronary artery bypass graft, chest and leg (donor) incisions

\*\*CABG-Chest only = coronary artery bypass graft, chest incision only (example: internal mammary artery)

**Table 7. Surgical patient component. Surgical site infection rates\*, by selected operative procedure and modified risk index category incorporating laparoscope use\*\*, January 1992-April 2000**

Operative Procedure Category	Duration Cutpoint (hrs)	Risk Index Category	N	Rate	Risk Index Category	N	Rate	Risk Index Category	N	Rate	Risk Index Category	N	Rate	Risk Index Category	N	Rate
CHOL Cholecystectomy	2	M	23913	0.46	0	20192	0.68	1	9654	1.81	2	3406	3.17	3	398	6.03
COLO Colon Surgery	3	M	384	1.30	0	10751	4.13	1	18856	5.83	2	8165	9.08	3	1126	11.37
APPY Appendectomy	1	0-Yes	1342	0.89	0-No	5343	1.40	1	6808	2.95	2	2569	4.94	3	295	9.49
GAST Gastric Surgery	3	0-Yes	251	0.40	0-No	1542	2.66	1	3151	4.98	2,3	1544	10.30	.	.	.

\* per 100 operations

\*\* This table uses a modified risk index that incorporates the influence of laparoscope or endoscope (SCOPE) on SSI rates. The influence of SCOPE on SSI rates was different across the four procedures:

- < For Cholecystectomy and Colon Surgery, when the operation was done laparoscopically, 1 was subtracted from the number of risk factors (ASA score of 3,4, or 5; duration of surgery >75<sup>th</sup> percentile; or contaminated or dirty wound class) in the NNIS risk index. For example, when two risk factors were present and the procedure was done laparoscopically, the new modified risk index category is 1 (i.e., 2-1=1). When no risk factors were present and the procedure was performed with a laparoscope, i.e., 0-1=-1, we designated this new modified risk category as minus 1 or “M”.
- < For Appendectomy and Gastric Surgery, the use of a SCOPE was important only if the patient had no other risk factors. We split patients with no other risk factors into two groups: ‘0-Yes’ which means laparoscope was used and ‘0-No’ when laparoscope was not used. For Gastric Surgery, since there was no difference in the rates when 2 or 3 risk factors were present, the rates for categories 2 and 3 were combined into a single category.

**Table 8. Surgical patient surveillance component. Surgical site infection rates\* following coronary artery bypass graft (CBGB) operation, by risk index category and specific site, NNIS system, January 1992-April 2000**

Infection Site	Risk Index Category							
	0		1		2		3	
	No. SSIs	Rate	No. SSIs	Rate	No. SSIs	Rate	No. SSIs	Rate
<b>Leg (donor site)</b>	<b>12</b>	<b>0.76</b>	<b>3194</b>	<b>1.60</b>	<b>1040</b>	<b>2.65</b>	<b>2</b>	<b>1.85</b>
<i>Superficial incisional</i>	9	0.57	2500	1.25	818	2.08	2	1.85
<i>Deep incisional</i>	3	0.19	694	0.35	222	0.56	0	0.00
<b>Chest</b>	<b>6</b>	<b>0.38</b>	<b>3913</b>	<b>1.96</b>	<b>1180</b>	<b>3.00</b>	<b>9</b>	<b>8.33</b>
<i>Superficial incisional</i>	4	0.25	1517	0.76	454	1.16	2	1.85
<i>Deep incisional</i>	0	0.00	1077	0.54	313	0.80	3	2.78
<i>Organ/space</i>	2	0.13	1319	0.66	413	1.05	4	3.70
<b>Total</b>	<b>18</b>	<b>1.14</b>	<b>7107</b>	<b>3.56</b>	<b>2220</b>	<b>5.65</b>	<b>11</b>	<b>10.19</b>

\*per 100 operations

Denominators for the risk categories are as follows:

Category 0 = 1,573

Category 1 = 199,807

Category 2 = 39,302

Category 3 = 108

**Table 9. ICARE Project. Pooled means and percentiles of the distribution of antimicrobial usage rates (DDD\* rates\*\*), by non-ICU inpatient areas and various types of ICU, January 1996 - November 2000**

Non-ICU Inpatient Areas (n=65)			Percentile				
Antimicrobial Agent	No. DDD*	Pooled Mean	10%	25%	50% (median)	75%	90%
Penicillin group	82,410	9.1	0.7	3.1	5.4	9.8	16.2
Ampicillin group	619,110	68.2	36.7	49.6	62.5	81.0	110.8
Antipseudomonal penicillins	149,763	16.5	2.4	7.6	16.9	27.3	36.5
Antistaphylococcal penicillins	134,288	14.8	2.7	4.4	11.5	16.7	24.2
First-generation cephalosporins	691,071	76.1	43.9	58.7	75.5	102.8	138.9
Second-generation cephalosporins	367,349	40.5	13.7	22.7	33.1	53.4	74.9
Third-generation cephalosporins	767,022	84.5	34.4	50.6	78.4	117.5	140.7
Carbapenem group	49,747	5.5	0.3	1.5	4.0	6.7	14.5
Aztreonam	21,793	2.4	0.1	0.7	1.5	3.7	7.0
Fluoroquinolones	529,527	58.3	24.8	39.5	60.7	88.4	138.2
Trimethoprim/sulfamethoxazole	346,739	38.2	1.1	18.3	27.2	44.1	87.5
Vancomycin (oral)	17,303	1.9	0.0	0.6	1.3	2.2	4.2
Vancomycin (parenteral)	251,296	27.7	13.1	16.8	24.4	33.6	60.9

\*Defined daily dose (DDD) of an antimicrobial agent is calculated by dividing the total grams of the antimicrobial agent used in a hospital area by the number of grams in an average daily dose of the agent given to an adult patient.

\*\* DDD per 1,000 patient-days =  $\frac{\text{DDD of specific agent used}}{\text{Total number of patient-days}} \times 1000$

Table 9 - continued

**Coronary Care Unit (n=31)**

Antimicrobial Agent	No. DDD*	Pooled Mean	Percentile				
			10%	25%	50% (median)	75%	90%
Penicillin group	587	4.9	0.0	0.2	1.6	10.2	17.6
Ampicillin group	4,640	38.8	10.4	20.7	37.0	71.4	87.6
Antipseudomonal penicillins	3,092	25.8	0.0	2.4	21.7	46.2	60.0
Antistaphylococcal penicillins	2,182	18.2	0.0	2.8	12.0	34.1	55.8
First-generation cephalosporins	6,344	53.0	9.0	27.8	37.5	54.8	104.9
Second-generation cephalosporins	4,245	35.5	2.5	9.2	23.2	34.6	53.9
Third-generation cephalosporins	14,427	120.6	29.6	47.3	120.3	143.8	187.1
Carbapenem group	978	8.2	0.0	0.0	6.1	10.2	27.4
Aztreonam	718	6.0	0.0	0.0	2.0	12.4	14.9
Fluoroquinolones	7,652	64.0	9.7	16.3	39.9	85.2	136.7
Trimethoprim/sulfamethoxazole	3,652	30.5	0.0	6.7	17.1	34.1	64.0
Vancomycin (oral)	466	3.9	0.0	0.0	0.0	1.1	6.7
Vancomycin (parenteral)	5,658	47.3	11.2	19.0	35.1	80.5	105.9

\*Defined daily dose (DDD) of an antimicrobial agent is calculated by dividing the total grams of the antimicrobial agent used in a hospital area by the number of grams in an average daily dose of the agent given to an adult patient.

\*\*DDD per 1,000 patient-days =  $\frac{\text{DDD of specific agent used}}{\text{Total number of patient-days}} \times 1000$

Table 9 - continued

**Cardiothoracic ICU (n=19)**

Antimicrobial Agent	No. DDD*	Pooled Mean	Percentile				
			10%	25%	50% (median)	75%	90%
Penicillin group	398	4.7	0.0	0.0	1.4	5.4	11.8
Ampicillin group	2,774	32.6	0.6	8.0	27.6	37.5	65.2
Antipseudomonal penicillins	2,247	26.4	0.0	2.6	16.0	38.9	54.9
Antistaphylococcal penicillins	1,386	16.3	0.0	0.0	6.4	19.9	29.2
First-generation cephalosporins	25,539	300.2	62.9	210.3	278.0	501.6	720.2
Second-generation cephalosporins	5,907	69.4	3.4	8.9	25.4	81.2	625.3
Third-generation cephalosporins	10,247	120.4	16.3	34.0	84.8	132.2	214.0
Carbapenem group	1,545	18.2	0.0	0.0	12.4	23.8	50.2
Aztreonam	664	7.8	0.0	0.2	1.0	5.3	26.7
Fluoroquinolones	4,867	57.2	6.2	12.1	42.0	119.6	165.4
Trimethoprim/sulfamethoxazole	1,047	12.3	0.0	0.0	7.6	13.9	100.9
Vancomycin (oral)	469	5.5	0.0	0.0	0.0	0.9	19.2
Vancomycin (parenteral)	10,753	126.4	21.6	45.6	97.0	190.0	355.9

\*Defined daily dose (DDD) of an antimicrobial agent is calculated by dividing the total grams of the antimicrobial agent used in a hospital area by the number of grams in an average daily dose of the agent given to an adult patient.

\*\*DDD per 1,000 patient-days =  $\frac{\text{DDD of specific agent used}}{\text{Total number of patient-days}} \times 1000$

Table 9 - continued

Hematology/Oncology/Transplant Wards (n=17)			Percentile				
Antimicrobial Agent	No. DDD*	Pooled Mean	10%	25%	50% (median)	75%	90%
Penicillin group	605	6.2	0.0	0.3	3.2	6.2	35.6
Ampicillin group	5,204	53.2	1.1	23.4	42.5	58.2	101.7
Antipseudomonal penicillins	3,134	32.0	5.8	11.5	25.5	45.6	86.7
Antistaphylococcal penicillins	1,429	14.6	1.2	2.7	7.4	23.2	38.3
First-generation cephalosporins	4,060	41.5	12.4	17.8	32.0	41.4	90.9
Second-generation cephalosporins	2,709	27.7	3.4	6.0	14.3	30.2	48.5
Third-generation cephalosporins	30,937	316.2	104.0	184.4	244.3	341.3	502.9
Carbapenem group	1,706	17.4	0.1	5.1	18.4	23.4	40.3
Aztreonam	816	8.3	1.1	3.1	5.8	12.6	38.3
Fluoroquinolones	13,802	141.1	28.0	75.7	142.5	229.7	306.7
Trimethoprim/sulfamethoxazole	3,768	38.5	0.0	22.2	29.4	56.2	101.4
Vancomycin (oral)	442	4.5	0.0	0.0	1.7	5.3	12.3
Vancomycin (parenteral)	9,416	96.2	32.1	65.1	99.6	125.0	271.9

\*Defined daily dose (DDD) of an antimicrobial agent is calculated by dividing the total grams of the antimicrobial agent used in a hospital area by the number of grams in an average daily dose of the agent given to an adult patient.

\*\* DDD per 1,000 patient-days =  $\frac{\text{DDD of specific agent used}}{\text{Total number of patient-days}} \times 1000$

Table 9 - continued

**Medical ICU (n=32)**

Antimicrobial Agent	No. DDD*	Pooled Mean	Percentile				
			10%	25%	50% (median)	75%	90%
Penicillin group	1,141	8.0	0.0	1.0	5.3	9.5	14.6
Ampicillin group	13,838	96.8	37.5	58.1	76.5	97.4	150.5
Antipseudomonal penicillins	10,617	74.3	13.3	25.4	65.5	110.7	121.7
Antistaphylococcal penicillins	4,720	33.0	0.7	7.2	21.3	39.7	58.5
First-generation cephalosporins	4,131	28.9	8.8	21.2	30.0	39.5	62.1
Second-generation cephalosporins	5,528	38.7	2.6	9.4	26.5	57.3	69.0
Third-generation cephalosporins	43,078	301.4	92.2	125.3	190.4	334.4	409.0
Carbapenem group	4,470	31.3	0.0	7.4	22.8	45.8	98.9
Aztreonam	1,115	7.8	0.0	2.0	6.9	13.8	17.7
Fluoroquinolones	16,746	117.2	29.5	51.2	86.9	149.6	273.4
Trimethoprim/sulfamethoxazole	8,398	58.8	1.9	20.9	37.3	60.7	106.8
Vancomycin (oral)	238	1.7	0.0	0.0	0.3	1.6	4.4
Vancomycin (parenteral)	14,131	98.9	42.9	55.3	74.1	141.2	210.7

\*Defined daily dose (DDD) of an antimicrobial agent is calculated by dividing the total grams of the antimicrobial agent used in a hospital area by the number of grams in an average daily dose of the agent given to an adult patient.

\*\* DDD per 1,000 patient-days =  $\frac{\text{DDD of specific agent used} \times 1000}{\text{Total number of patient-days}}$



Table 9 - continued

**Medical-Surgical ICU (n=53)**

Antimicrobial Agent	No. DDD*	Pooled Mean	Percentile				
			10%	25%	50% (median)	75%	90%
Penicillin group	2,002	6.3	0.0	0.2	1.8	5.5	17.8
Ampicillin group	26,350	82.9	24.9	42.0	67.4	110.9	139.6
Antipseudomonal penicillins	24,274	76.4	17.0	36.9	59.8	92.0	132.8
Antistaphylococcal penicillins	7,022	22.1	0.0	4.7	8.3	20.9	44.4
First-generation cephalosporins	37,781	118.9	25.1	61.4	83.8	127.6	215.9
Second-generation cephalosporins	16,661	52.4	4.7	12.7	33.5	53.3	104.3
Third-generation cephalosporins	68,415	215.3	85.0	122.9	192.8	267.9	322.1
Carbapenem group	9,763	30.7	3.4	6.4	22.2	40.0	56.5
Aztreonam	3,325	10.5	0.0	1.7	7.0	14.5	25.3
Fluoroquinolones	44,111	138.8	38.8	64.4	115.6	199.6	284.9
Trimethoprim/sulfamethoxazole	12,680	39.9	0.0	9.8	17.6	39.1	100.7
Vancomycin (oral)	1,901	6.0	0.0	0.0	2.0	6.2	10.9
Vancomycin (parenteral)	24,117	75.9	31.3	48.9	63.0	106.4	135.2

\*Defined daily dose (DDD) of an antimicrobial agent is calculated by dividing the total grams of the antimicrobial agent used in a hospital area by the number of grams in an average daily dose of the agent given to an adult patient.

\*\*DDD per 1,000 patient-days =  $\frac{\text{DDD of specific agent used} \times 1000}{\text{Total number of patient-days}}$

Table 9 - continued

## Neurosurgical ICU (n=11)

Antimicrobial Agent	No. DDD*	Pooled Mean	Percentile				
			10%	25%	50% (median)	75%	90%
Penicillin group	346	7.1	0.0	0.0	5.2	15.2	20.5
Ampicillin group	2,537	52.5	14.6	18.8	55.0	63.7	70.4
Antipseudomonal penicillins	2,030	42.0	17.9	20.4	36.1	44.3	53.1
Antistaphylococcal penicillins	2,718	56.2	2.1	5.0	23.1	70.6	142.6
First-generation cephalosporins	6,199	128.2	62.4	69.7	113.8	170.1	249.9
Second-generation cephalosporins	1,052	21.8	2.2	5.5	7.4	27.2	27.4
Third-generation cephalosporins	10,590	218.6	43.7	131.6	183.8	314.7	339.4
Carbapenem group	1,250	25.9	0.0	0.0	8.2	47.0	49.0
Aztreonam	77	1.6	0.0	0.0	0.7	4.2	4.3
Fluoroquinolones	3,247	67.1	31.5	42.0	65.6	141.4	172.4
Trimethoprim/sulfamethoxazole	1,177	24.3	0.0	1.5	20.7	41.5	45.4
Vancomycin (oral)	74	1.5	0.0	0.0	0.0	0.2	4.6
Vancomycin (parenteral)	4,776	98.8	52.0	62.8	90.6	124.9	138.6

\*Defined daily dose (DDD) of an antimicrobial agent is calculated by dividing the total grams of the antimicrobial agent used in a hospital area by the number of grams in an average daily dose of the agent given to an adult patient.

\*\*DDD per 1,000 patient-days =  $\frac{\text{DDD of specific agent used}}{\text{Total number of patient-days}} \times 1000$

**Table 9 - continued**

**Surgical ICU (n=31)**

Antimicrobial Agent	No. DDD*	Pooled Mean	Percentile				
			10%	25%	50% (median)	75%	90%
Penicillin group	1,457	9.6	0.0	0.7	3.7	10.6	16.7
Ampicillin group	15,581	102.5	28.8	53.6	87.9	150.6	186.4
Antipseudomonal penicillins	8,307	54.6	4.7	21.8	56.1	77.0	105.7
Antistaphylococcal penicillins	4,224	27.8	0.7	2.7	13.5	35.6	55.3
First-generation cephalosporins	31,793	209.1	64.1	105.7	193.9	335.5	490.2
Second-generation cephalosporins	7,829	51.5	3.7	24.6	50.5	84.6	96.1
Third-generation cephalosporins	27,924	183.7	73.3	113.2	142.8	205.6	222.8
Carbapenem group	6,768	44.5	1.4	7.4	23.3	54.5	71.5
Aztreonam	1,282	8.4	1.6	4.6	7.7	12.5	19.3
Fluoroquinolones	15,010	98.7	34.2	45.3	83.8	107.0	166.1
Trimethoprim/sulfamethoxazole	6,707	44.1	4.6	12.7	23.9	44.0	92.3
Vancomycin (oral)	863	5.7	0.0	0.0	1.5	3.5	11.9
Vancomycin (parenteral)	17,419	114.6	54.8	64.7	104.3	156.6	169.6

\*Defined daily dose (DDD) of an antimicrobial agent is calculated by dividing the total grams of the antimicrobial agent used in a hospital area by the number of grams in an average daily dose of the agent given to an adult patient.

\*\*DDD per 1,000 patient-days =  $\frac{\text{DDD of specific agent used}}{\text{Total number of patient-days}} \times 1000$

Table 9 - continued

**Pediatric ICU (n=16)**

Antimicrobial Agent	No. DDD*	Pooled Mean	Percentile				
			10%	25%	50% (median)	75%	90%
Penicillin group	289	6.2	0.0	1.0	2.3	9.2	9.7
Ampicillin group	2,023	43.3	7.5	21.6	49.9	64.0	68.3
Antipseudomonal penicillins	585	12.5	0.0	0.9	6.2	22.8	34.6
Antistaphylococcal penicillins	1,301	27.9	0.0	9.1	21.8	33.5	48.6
First-generation cephalosporins	2,167	46.4	12.0	24.9	38.0	75.6	113.9
Second-generation cephalosporins	1,710	36.6	11.1	18.2	32.0	52.8	115.0
Third-generation cephalosporins	9,058	194.1	39.6	75.8	128.2	242.2	386.0
Carbapenem	276	5.9	0.0	0.0	1.1	10.7	15.1
Aztreonam	90	1.9	0.0	0.0	0.0	0.4	4.6
Fluoroquinolones	379	8.1	0.0	0.0	3.1	11.3	17.8
Trimethoprim/sulfamethoxazole	624	13.4	0.0	0.0	6.6	11.9	38.7
Vancomycin (oral)	151	3.2	0.0	0.0	0.0	2.4	15.7
Vancomycin (parenteral)	2,769	59.3	7.5	17.7	64.6	77.0	106.6

\*Defined daily dose (DDD) of an antimicrobial agent is calculated by dividing the total grams of the antimicrobial agent used in a hospital area by the number of grams in an average daily dose of the agent given to an adult patient.

\*\*DDD per 1,000 patient-days =  $\frac{\text{DDD of specific agent used} \times 1000}{\text{Total number of patient-days}}$

**Table 10. ICARE Project. Pooled means and percentiles of the distribution of antimicrobial resistance rates\*, by all ICUs combined, non-ICU inpatient units and by outpatients, January 1996 - November 2000**

All ICUs Combined				Percentile				
Antimicrobial-resistant Pathogen	No. Units	No. Tested	Pooled Mean	10%	25%	50% (median)	75%	90%
MRSA	183	20,673	46.5	15.4	25.0	43.2	56.5	66.7
Methicillin-resistant CNS	174	14,756	74.9	56.9	68.0	75.6	81.6	86.7
Vancomycin-resistant <i>Enterococcus</i>	160	13,281	11.3	0.0	3.0	9.9	18.1	30.9
Ciprofloxacin/ofloxacin-resistant <i>Pseudomonas aeruginosa</i>	162	13,784	29.9	4.2	10.2	19.7	33.3	46.4
Levofloxacin-resistant <i>P aeruginosa</i>	45	2,374	37.8	10.0	18.2	28.8	39.4	55.6
Imipenem-resistant <i>P aeruginosa</i>	146	11,589	16.7	0.0	5.9	11.0	21.8	31.3
Ceftazidime-resistant <i>P aeruginosa</i>	152	12,759	11.7	0.0	3.8	9.8	15.7	25.0
Piperacillin-resistant <i>P aeruginosa</i>	145	11,441	15.0	0.0	5.3	13.0	17.9	31.6
Cef3-resistant <i>Enterobacter</i> spp	128	5,505	25.9	10.0	17.9	26.4	37.5	50.9
Carbapenem-resistant <i>Enterobacter</i> spp	77	2,796	0.9	0.0	0.0	0.0	0.0	4.0
Cef3-resistant <i>Klebsiella pneumoniae</i>	136	7,376	5.4	0.0	0.0	1.3	7.5	18.5
Cef3-resistant <i>Escherichia coli</i>	160	11,777	0.9	0.0	0.0	0.0	1.7	6.5
Quinolone-resistant <i>E coli</i>	155	11,375	4.2	0.0	0.0	0.0	5.0	11.1
Penicillin-resistant pneumococcus	56	1,308	16.4	0.0	0.0	9.1	27.6	50.0
Cefotaxime/ceftriaxone-resistant pneumococcus	27	494	8.7	0.0	0.0	4.4	15.4	29.4

MRSA=Methicillin-resistant *Staphylococcus aureus*; CNS=coagulase-negative *Staphylococcus*; Cef3=ceftazidime, cefotaxime, or ceftriaxone; Quinolone=ciprofloxacin, ofloxacin, or levofloxacin; Carbapenem = imipenem or meropenem

\*For each antimicrobial agent and pathogen combination, resistance rates were calculated as:

$$\frac{\text{Number of resistant isolates}}{\text{Number of isolates tested}} \times 100$$

Table 10-continued

Non-ICU Inpatient Areas				Percentile				
Antimicrobial-resistant Pathogen	No. Units	No. Tested	Pooled Mean	10%	25%	50% (median)	75%	90%
MRSA	64	39,296	36.0	18.0	27.1	36.3	47.3	53.5
Methicillin-resistant CNS	63	27,294	62.1	51.6	57.2	63.0	67.7	73.7
Vancomycin-resistant <i>Enterococcus</i>	61	34,068	9.9	0.9	2.2	4.8	10.9	18.6
Ciprofloxacin/ofloxacin-resistant <i>Pseudomonas aeruginosa</i>	61	24,471	22.6	11.8	15.9	22.8	30.2	34.0
Levofloxacin-resistant <i>P aeruginosa</i>	20	3,652	27.9	13.6	19.0	26.4	31.4	39.2
Imipenem-resistant <i>P aeruginosa</i>	57	18,684	11.5	3.3	6.1	9.4	13.7	16.7
Ceftazidime-resistant <i>P aeruginosa</i>	59	22,764	7.5	1.0	3.3	6.2	11.9	16.2
Piperacillin-resistant <i>P aeruginosa</i>	58	19,300	9.9	2.7	5.2	8.2	12.5	18.6
Cef3-resistant <i>Enterobacter</i> spp	60	8,945	21.2	9.0	13.7	20.7	27.4	32.3
Carbapenum-resistant <i>Enterobacter</i> spp	38	3,243	1.3	0.0	0.0	0.0	1.8	5.9
Cef3-resistant <i>Klebsiella pneumoniae</i>	60	15,659	4.9	0.0	0.4	1.9	4.4	9.0
Cef3-resistant <i>Escherichia coli</i>	63	42,988	0.8	0.0	0.0	0.5	1.1	2.2
Quinolone-resistant <i>E coli</i>	62	41,498	3.0	0.0	0.5	1.3	2.9	4.9
Penicillin-resistant pneumococcus	52	4,148	15.0	2.1	5.3	10.3	20.3	31.5
Cefotaxime/ceftriaxone-resistant pneumococcus	25	1,304	8.1	0.0	1.6	5.6	10.5	14.3

\*For each antimicrobial agent and pathogen combination, resistance rates were calculated as:

$$\frac{\text{Number of resistant isolates}}{\text{Number of isolates tested}} \times 100$$

Table 10 - continued

Outpatient Areas				Percentile				
Antimicrobial-resistant Pathogen	No. Units	No. Tested	Pooled Mean	10%	25%	50% (median)	75%	90%
Methicillin-resistant <i>S. aureus</i>	57	31,508	21.0	7.9	15.5	22.2	28.1	34.6
Methicillin-resistant CNS	56	18,393	45.2	33.3	41.6	46.1	51.6	58.5
Vancomycin-resistant <i>Enterococcus</i>	55	21,660	3.9	0.0	1.0	2.7	4.9	8.1
Ciprofloxacin/ofloxacin-resistant <i>Pseudomonas aeruginosa</i>	57	15,325	21.8	12.0	16.5	22.6	28.1	36.0
Levofloxacin-resistant <i>P aeruginosa</i>	18	2,407	24.6	5.9	15.1	21.0	25.5	38.2
Imipenem-resistant <i>P aeruginosa</i>	53	10,895	7.2	1.8	3.4	6.5	9.7	12.9
Ceftazidime-resistant <i>P aeruginosa</i>	56	13,585	4.6	0.5	2.2	3.7	6.7	12.2
Piperacillin-resistant <i>P aeruginosa</i>	51	11,800	5.6	0.8	2.0	4.2	7.2	12.4
Cef3-resistant <i>Enterobacter</i> spp	52	5,574	9.6	2.5	5.4	7.9	14.0	17.2
Carbapenem-resistant <i>Enterobacter</i> spp	35	1,864	0.9	0.0	0.0	0.0	0.0	2.4
Cef3-resistant <i>Klebsiella pneumoniae</i>	56	14,255	1.4	0.0	0.0	0.8	1.9	6.0
Cef3-resistant <i>Escherichia coli</i>	58	84,141	0.3	0.0	0.0	0.2	0.6	1.1
Quinolone-resistant <i>E coli</i>	56	75,626	1.4	0.0	0.4	1.4	2.3	2.9
Penicillin-resistant pneumococcus	49	4,444	15.6	2.9	5.0	10.0	16.7	40.0
Cefotaxime/ceftriaxone-resistant pneumococcus	31	1,684	6.4	0.0	0.0	3.8	10.0	26.7

\*For each antimicrobial agent and pathogen combination, resistance rates were calculated as:

$$\frac{\text{Number of resistant isolates}}{\text{Number of isolates tested}} \times 100$$

**Appendix A. ICARE Project. Defined Daily Dose (DDD) of antimicrobial agents, by class and group<sup>1</sup>**

<b>Class</b>	<b>Group</b>	<b>Antimicrobial Agent</b>	<b>DDD</b>
â-lactams	Penicillin group	Penicillin G	12 x 10 <sup>6</sup> U
		Procaine Penicillin G	2.4 x 10 <sup>6</sup> U
		Penicillin G benzathine	1.2 x 10 <sup>6</sup> U
		Penicillin V	1 g
	Ampicillin group	Ampicillin (parenteral)	4g
		Ampicillin (oral)	2g
		Ampicillin/sulbactam	6g
		Amoxicillin (oral)	1.5g
		Amoxicillin/Clavulanic Acid (oral)	1.5g
	Antistaphylococcal penicillins (Methicillin group)	Nafcillin	4g
		Oxacillin	4g
		Dicloxacillin (oral)	2g
	Antipseudomonal penicillins	Piperacillin	18g
		Piperacillin/Tazobactam	13.5g
		Ticarcillin	18g
		Ticarcillin/Clavulanic Acid	12.4g
	1st-Generation cephalosporins	Cefazolin	3g
		Cephalothin	4g
		Cefadroxil (oral)	2g
		Cephalexin (oral)	2g
	2nd-Generation cephalosporins	Cefotetan	2g
		Cefmetazole	4g
		Cefoxitin	4g
		Cefuroxime	3g
		Cefuroxime axetil (oral)	1g
		Cefaclor (oral)	1g
		Cefprozil (oral)	1g
	3rd-Generation cephalosporins	Cefotaxime	3g
		Ceftazidime	3g
		Ceftizoxime	3g
		Ceftriaxone	1g
		Cefixime (oral)	0.4g
		Cefipime	4g
	Carbapenems	Meropenem	3g
		Imipenem cilastatin	2g

<sup>1</sup>Adapted from Amsden GW, Schentag JJ. Tables of antimicrobial agent pharmacology. In: Mandell GL, Bennett JE, Dolin R, eds. Principles and practice of infectious diseases, 4th edition. New York: Churchill Livingstone, 1995:492-528.



<b>Class</b>	<b>Group</b>	<b>Antimicrobial Agent</b>	<b>DDD</b>
Other $\beta$ -Lactams		Aztreonam	4g
Glycopeptides		Vancomycin (parenteral)	2g
		Vancomycin (oral)	1g
Fluoroquinolones		Ciprofloxacin (parenteral)	0.8g
		Ciprofloxacin (oral)	1.5g
		Ofloxacin (parenteral)	0.8g
		Ofloxacin (oral)	0.8g
		Levofloxacin (parenteral)	0.5g
		Levofloxacin (oral)	0.2g
		Trovafloxacin (parenteral)	0.2g
		Trovafloxacin (oral)	0.2g
		Sparfloxacin (oral)	0.2g
		Norfloxacin (oral)	0.8g
		Lomefloxacin	0.4g
Trimethoprim/ Sulfamethoxazole		Trimethoprim component (oral)	0.32g
		Trimethoprim compound (parenteral)	0.84g

## **Appendix B. How to calculate device-associated infection rates and device utilization ratios using ICU and HRN surveillance component data**

### **Calculation of Device-associated Infection Rate**

- Step 1:** Decide upon the time period for your analysis. It may be a month, a quarter, 6 months, a year, or some other period.
- Step 2:** Select the patient population for analysis, i.e., the type of ICU or a birthweight category in the HRN.
- Step 3:** Select the infections to be used in the numerator. They must be site-specific and must have occurred in the selected patient population. Their date of onset must be during the selected time period.
- Step 4:** Determine the number of device-days which is used as the denominator of the rate. Device-days are the total number of days of exposure to the device (central line, ventilator, or urinary catheter) by all of the patients in the selected population during the selected time period.

**Example 1:** Five patients on the first day of the month had one or more central lines in place; five on day 2; two on day 3; five on day 4; three on day 5; four on day 6; and four on day 7. Adding the number of patients with central lines on days 1 through 7, we would have  $5+5+2+5+3+4+4=28$  central line-days for the first week. If we continued for the entire month, the number of central line-days for the month is simply the sum of the daily counts.

- Step 5:** Calculate the device-associated infection rate (per 1000 device-days) using the following formula:

$$\text{Device-associated Infection Rate} = \frac{\text{Number of device-associated infections for a specific site} \times 1000}{\text{Number of device-days}}$$

**Example 2: Central line-associated BSI rate per 1000 central line-days =**

$$\frac{\text{Number of central line-associated BSI} \times 1000}{\text{Number of central line-days}}$$

## Calculation of Device Utilization (DU) Ratio

**Steps 1,2,4:** Same as device-associated infection rates plus determine the number of patient-days which is used as the denominator of the DU ratio. Patient-days are the total number of days that patients are in the ICU (or HRN) during the selected time period (sum of the '# patients' column on the monthly ICU and HRN data collection forms).

**Example 3:** Ten patients were in the unit on the first day of the month; 12 on day 2; 11 on day 3; 13 on day 4; 10 on day 5; 6 on day 6; and 10 on day 7; and so on. If we counted the patients in the unit from days 1 through 7, we would add 10 + 12 + 11 + 13 + 10 + 6 + 10 for a total of 72 patient-days for the first week of the month. If we continued for the entire month, the number of patient-days for the month is simply the sum of the daily counts.

**Step 5:** Calculate the DU ratio using the following formula:

$$\text{Device Utilization (DU) Ratio} = \frac{\text{Number of device-days}}{\text{Number of patient-days}}$$

Using the number of device-days and patient-days from Examples 1 and 3 above,  $DU = 28/72 = 0.39$  or 39% of patient-days were also central line-days for the first week of the month.

**Step 6:** Examine the size of the denominator for your hospital's rate or ratio. Rates or ratios may not be good estimates of the "true" rate or ratio for your hospital if the denominator is small, i.e., <50 device-days or patient-days.

**Step 7:** Compare your hospital's ICU/HRN rates or ratios with those found in the tables of this report. Refer to Appendix C for interpretation of the percentiles of the rates/ratios.

*To calculate the device-associated infection rates and device utilization ratios for your ICU or HRN in IDEAS, first enter the time period of interest in Option 10 of the OPM. Then select either OPM Option 21 or 22 to include infections based on date of infection onset. Next, select OPM Option 32 for ICU or Option 33 for HRN. From these data analysis menus, device-associated infection rates and device utilization ratios can be automatically calculated using Options 31 or 32.*

## Appendix C. How to interpret percentiles of infection rates or device utilization ratios

- Step 1:** Evaluate the rate (ratio) you have calculated for your hospital and confirm that the variables in the rate (both numerator and denominator) are identical to the rates (ratios) in the table.
- Step 2:** Examine the percentiles in each of the tables and look for the 50th percentile (or median). At the 50th percentile, 50% of the hospitals have lower rates (ratios) than the median and 50% have higher rates (ratios).
- Step 3:** Determine if your hospital's rate (ratio) is above or below this median.

### Determining if your hospital's rate or ratio is a **HIGH** outlier

- Step 4:** If it is above the median, determine whether the rate (ratio) is above the 75th percentile. At the 75th percentile, 75% of the hospitals had **lower** rates (ratio) and 25% of the hospital had higher rates (ratio).
- Step 5:** If the rate (ratio) is above the 75th percentile, determine whether it is above the 90th percentile. If it is, then the rate (or ratio) is a high outlier which **may** indicate a problem.

### Determining if your hospital's rate or ratio is a **LOW** outlier

- Step 6:** If it is below the median, determine whether the rate (ratio) is below the 25th percentile. At the 25th percentile, 25% of the hospitals had **lower** rates (ratios) and 75% of the hospitals had higher rates (ratios).
- Step 7:** If the rate (ratio) is below the 25th percentile, determine whether it is below the 10th percentile. If the rate is, then it is a low outlier which **may** indicate a problem with underreporting of infections. If the ratio is below the 10th percentile, it is a low outlier and indicates infrequent and/or short duration of device use.

**Note:** Device-associated infection rates and device utilization ratios should be examined together so that preventive measures may be appropriately targeted. For example, you find that the ventilator-associated pneumonia rate for a certain type of ICU is consistently above the 90th percentile and the ventilator utilization ratio is routinely between the 75th and 90th percentile. Since the ventilator is a significant risk factor for pneumonia, you may want to target your efforts on reducing the use of ventilators or limiting the duration with which they are used on patients in order to lower the pneumonia rate in the unit.

## **Appendix D. How to use IDEAS to calculate SSI rates from the surgical patient surveillance component**

*If you have been following the surgical patient surveillance component and wish to calculate SSI rates in IDEAS, first enter the time period of interest in Option 10 of the OPM. Then select either OPM Option 23 or 24 to include infections based on date of surgery. Next, select OPM Option 34 to go to the SP Component Data Analysis Menu. Select Option 35 for the SP Rates Menu #1. Here, modify the SP filter (Option 60) to include only SSI and specify operative procedures and/or surgeons, if desired. For example:*

majsite = ssi  
and srgoper = cbgb or cbgc  
and surgeon = 12345

*Select SP Rates Menu #1 Option 1 to calculate SSI rates by operative procedure and risk index category. Select Option 5 to calculate SSI rates by operative procedure and risk index category by surgeon.*